17th WEDC Conference

Infrastructure, environment, water and people

Nairobi, Kenya 1991

Water tanks with HFB technique

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ABSTRACT

In extended areas of the world water is so scarce that for many people the possibility of storing drinking water is of vital importance.

This Paper describes a very simple technique for water tank construction called H-F-B (heart filled blocks). The technique makes use of a simple mould (which can be made even in rural areas) for the manufacture of concrete building blocks. The block production is easy and requires the use of neither energy nor skilled workmen.

THE HFB TECHNIQUE

The heart filled block is a specially designed hollow block that is prepared using a metal or wooden mould.

The moulds (and consequently the blocks) can be either straight or curved thus allowing the construction of rectangular or circular tanks.

The tank construction begins with a standard supporting slab. Once the slab is settled, the blocks are placed one on top of the other without the aid of mortar. After every second row, a slurry of sand-cement or soil-cement is poured over the top, filling the interconnected hollows and producing, when cured, a monolithic structure.

This innovative part of the technique is very quick and does not even require personnel with brick laying skills. Provided the slab is ready and the blocks already produced, the walls of a 5 m^3 tank can be built in a few hours. A height of 2 m is the maximum recommended for structural reasons and for ease of building. Inside plastering will ensure protection against leakages.
A cover to prevent contaminations can be made from local materials or even a thin concrete lid will be the last item for the structure.

The Blocks

The blocks are standard as regards the building materials (cement-sand-gravel).

The innovation lies in the shape and the position of the holes.

As these blocks are not laid with mortar interconnecting them, but placed freely and loosely one on top of the other, it is very important that the holes of the blocks in a certain layer match with the holes of the corresponding blocks in the upper and lower layers. This will allow the slurry to fill all the free spaces interconnecting them and thus form the monolithic structure.

Provided this important condition is maintained, any shape and size of holes can be used when designing the mould for the blocks.

The holes should be placed two at the ends and one at the centre. This is a condition for the holes to correlate with upper and lower block holes. Therefore the minimal number of holes for a block is 3.

As regards the size of the holes and the block wall thickness, it can be said that the best and cheapest block is the one with the thinnest walls. The reason is that if the block walls are thin, less mortar is required for the construction and more slurry is used later. The mortar is expensive, the slurry cheap. In addition big holes will allow a fluid slurry passage and interconnecting, and finally, a block with thin walls is easy to handle, lift and place in the tank wall.

Nevertheless, it should be considered that no block wall should ever be thinner than 2.5 cm.

Two general shapes of blocks can be used: curved or straight, and rectangular. The first will allow the construction of circular tanks, the second square or rectangular tanks.

The pieces to produce the holes can be made of iron, wood, PVC piping or iron piping.

Any shape is allowed, but obviously circular or square are recommended. Top handles in these pieces will help the production of blocks.

Finally, and in relation to the block size practical reasons condition the length to a minimum of 30 cm and a maximum of 50 cm.

If the shape is rectangular, then it is important to produce a block with a:

Ratio length: width	2:1
Height	20-25 cm

The Blocks

People all around the world produce blocks using a cement:aggregate ratio ranging from 1:3 to 1:7. According to the experience gathered, this paper will suggest working with a

cement: aggregate ratio 1:5

A mortar with such a ratio makes use of a relatively small amount of cement (economic) but still it presents a considerably good structural strength.

As regards the type of aggregates, the two basic components are sand (the best sand is a mixture of fine and coarse sands), and gravel (no more than 10 mm in diameter).

The recommended mixtures are:

C	S	G
1	5	
1	4	1
1	3	2
1	2	3

The tank builder should choose the mixture most suited to his needs, keeping in mind that coarse aggregate blends produce open-textured blocks while fine mixtures produce smooth, dense surfaces.

For block production follow this technique step by step:

- Put the mould on a clean and even floor.
- Put the hole-producing pieces in place.
- Fill the free spaces in the mould with mixture.
- Shake the mould (taking hold of handles) for about 30 seconds.
- Add more mixture to the free spaces in the mould.
- Shake for another 30 seconds.
- Make sure the upper surface is even.
- Take out the hole-producing pieces by lifting with the handles.
- Lift external mould carefully.

The Tank

Once the slab and the blocks are ready, it it time to start building the tank.

This is also very simple and the technique is as follows:

- Place the first row of blocks on the slab, following the array previously chosen for a certain perimeter.
- Be sure that the blocks are placed tightly next to each other.

It is suggested that this first row should be filled with a stronger mortar e.g. 1:3.

- Place a second and third row each on top of the previous. The blocks in adjoining rows should be cross linked (i.e. the side-end of one block should correspond with the centres of the blocks in the upper and lower rows).
- Pour a slurry of soil-cement or sand-cement through the holes of the upper row.
- The slurry should be conveniently flowing to fill all the empty spaces, but consistent enough to escape through the very tiny interspaces.
- Place two more rows of blocks and pour soil cement.
- Continue this way until reaching the desired height.

The tank built in accordance with these instructions should be quite homogeneous, with no cracks or holes in its walls. But it is possible that small fissures and even the natural porosity of the blocks may allow the passage of water from the inside to the exterior.

For this reason it is necessary to plaster the inside walls and the slab surface.

The thickness of the plaster layer should be approximately 1.5 cm.

Linked to the tank finishing activities comes the moment of placing a tap and a drain outlet. The tap will allow the user to get water from the tank.

The drain (nipple with valve) will allow the sediments and eventual dirt to be washed out.

Both tap and drain are attached to a nipple connecting the tank exterior with the interior.

SUMMARY OF RELEVANT INFORMATION

SLAB

Concrete

Ratio C - S - G = 1:2:3

Quantities for 1 m^3 concrete

C	300 kg
S	0.5 m^3
G	0.75 m^3

Blocks

Ration cement/aggregate = 1:5

Recommended mixtures and quanitities for 1 m^3.

C	S	G	C(kg)	S(m^3)	G(m^3)
1	5		300	1.25	0.25
1	4	1	300	1.0	0.25
1	3	2	300	0.75	0.75
1	2	3			

Slurry

Ration cement: sand/soil 1:10

Quantities for 1 m³ mixture
Cement 150 kg
Sand/soil 1 m³

Plastering

Ratio cement : sand 1:3

Quantities for 1 m³ mixture
Cement 500 kg
Sand 1 m³

This paper is based on a technical guide "RURAL WATER TANKS WITH HFB TECHNIQUE".

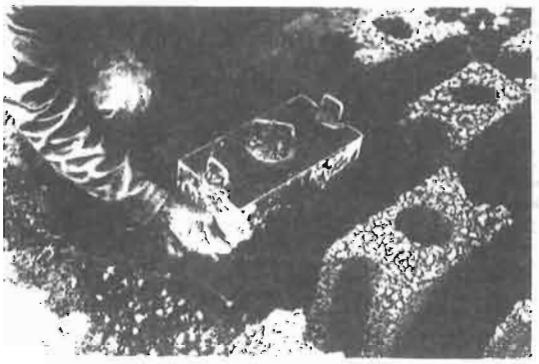
The guide describes in detail the process of tank construction with figures, examples and photographs.

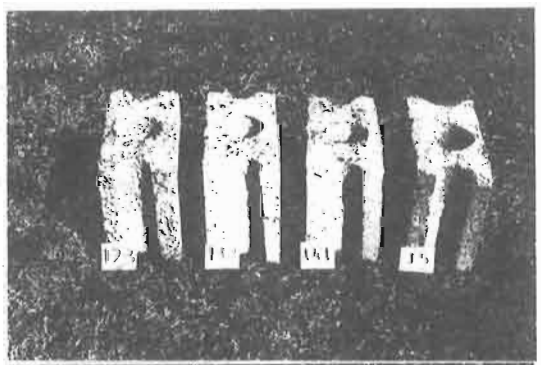
The selling price of the guide outside South Africa is US$ 10 which includes local tax and mailing. (Cheque orders to CSIR).

The guide can be ordered from:

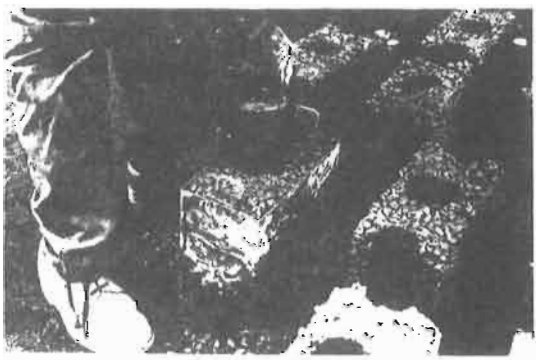
CSIR
Division of Water Technology
P O Box 395
PRETORIA 0001
Republic of South Africa.

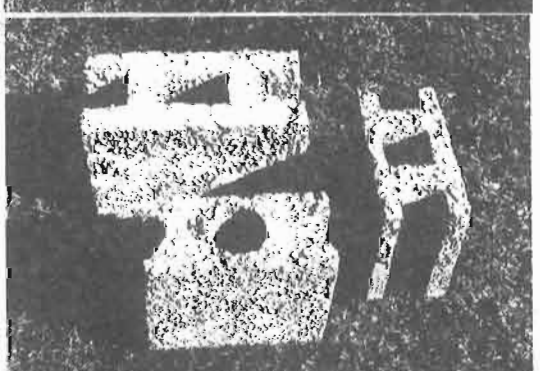
BLOCK PRODUCTION



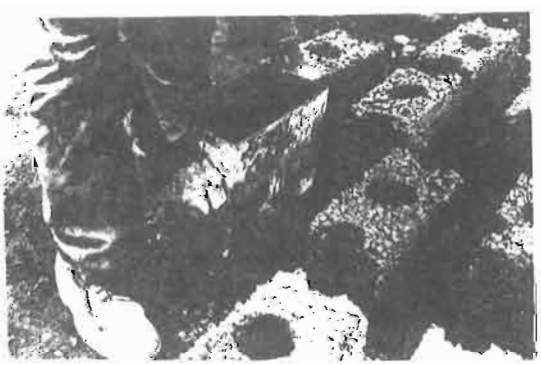


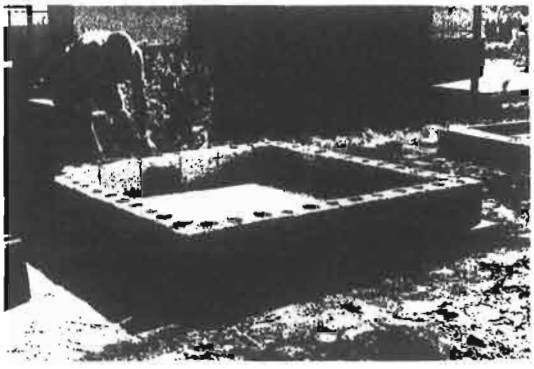
DIFFERENT C:S:G BLOCKS

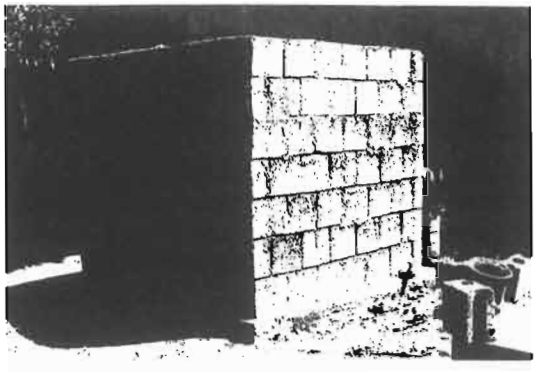




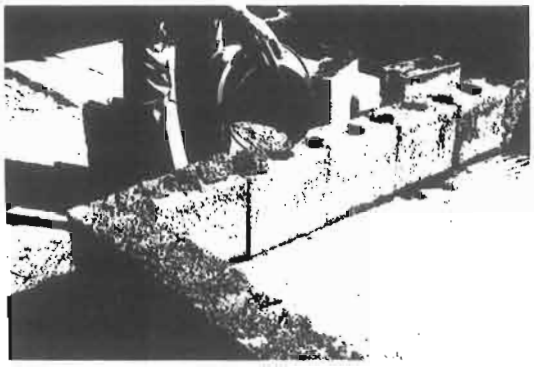
BLOCKS





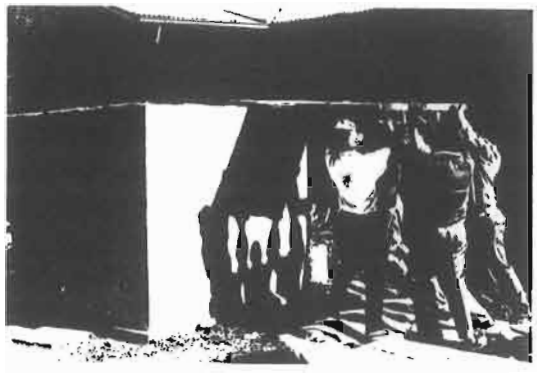


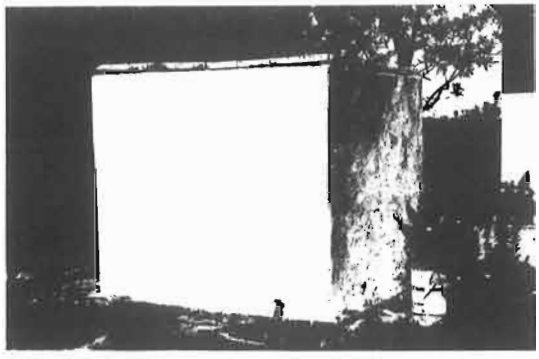
TANK



HFB BUILDING TECHNIQUE

PLASTERING





TANK BY HFB TECHNIQUE